

**CLAIMS**

What is claimed is:

1. A method for monitoring in-situ a chemical composition at or near a surface of a wafer during plasma etch to detect defects comprising:  
5 providing a semiconductor substrate comprising at least one top layer, wherein the semiconductor substrate comprises at least one chemical-containing contaminant;  
subjecting the semiconductor substrate to a plasma etch process, whereby at least a portion of the top layer is removed;  
10 during the plasma etch process, detecting for a presence of the chemical-containing contaminant using one of an Auger Electron Spectroscopy system or Energy Dispersive X-ray Analysis system; and  
if present, determining whether the presence of the chemical-containing contaminant exceeds a threshold limit.
- 15 2. The method of claim 1, wherein the at least one chemical-containing contaminant includes any one of carbon, calcium, sulfur, aluminum, tungsten and nickel.
3. The method of claim 1, wherein the semiconductor substrate is enclosed in a plasma etch chamber during the plasma etch process.
- 20 4. The method of claim 3, wherein the plasma etch chamber comprises at least one chemical-contaminant-sensitive detector systems.
- 25 5. The system of claim 1, wherein the defect detector, using one of an Auger Electron Spectroscopy system or Energy Dispersive X-ray Analysis system, indicates the presence of the one or more chemical contaminants at or below a top surface of the top layer.

6. The system of claim 5, wherein the Auger electron spectroscopy system indicates the presence of the one or more chemical contaminants at a top surface of the top layer and at about a 1-5 nm depth from the top layer surface.

7. The system of claim 5, wherein the Energy Dispersive X-ray Analysis system indicates the presence of the one or more chemical contaminants at about 1-2  $\mu\text{m}$  from the top layer surface.

8. The system of claim 1, further comprising suspending a semiconductor fabrication process if the chemical-containing contaminant exceeds the threshold limit.

9. A system for monitoring in-situ a chemical composition at or near a surface of a wafer during plasma etch to detect defects comprising:

- a semiconductor substrate comprising at least one top layer, wherein the semiconductor substrate comprises at least one chemical-containing contaminant;
- a plasma etch chamber in which the wafer is placed to undergo a plasma etch process;
- a defect detector operatively coupled to the plasma etch chamber and comprising one or more sensor systems, the one or more sensor systems being at least one of an Auger Electron Spectroscopy system or an Energy Dispersive X-ray Analysis system, wherein the defect detector detects the chemical-containing contaminant;
- a defect analyzer operatively coupled to the defect detector for determining whether the presence of the chemical-containing contaminant exceeds a threshold limit; and
- a fabrication process controller operatively coupled to the defect analyzer for determining whether to the fabrication process or to continue the fabrication process.

10. The system of claim 9, wherein the one or more chemical contaminants including carbon, calcium, sulfur, aluminum, tungsten and nickel.

11. The system of claim 9, wherein the defect detector signals when the presence of the one or more chemical contaminants is detected.

12. The system of claim 9, further comprising fabrication process components operatively coupled to the plasma etch chamber and to the fabrication process controller for manufacturing the semiconductor substrate.

13. The system of claim 9, wherein the Auger Electron Spectroscopy system indicates the presence of the one or more chemical contaminants at the surface of the top layer or at about a 1-5 nm depth from the top layer surface.

14. The system of claim 9, wherein the Energy Dispersive X-ray Analysis system indicates the presence of the one or more chemical contaminants at about a 1-2  $\mu\text{m}$  depth from the top layer surface.

15. The system of claim 9, wherein the defect detector determines an amount of the one or more chemical contaminants present.

16. The system of claim 15, wherein the fabrication process controller determines whether the fabrication process continues or terminates based on the determined amount of the one or more chemical contaminants.

17. A system for monitoring in-situ a chemical composition  
at or near a top surface of a wafer during plasma etch to detect defects comprising:  
means for providing a semiconductor substrate comprising at least one  
top layer, wherein the semiconductor substrate comprises at least one chemical-  
containing contaminant;  
5 means for subjecting the semiconductor substrate to a plasma etch  
process, whereby at least a portion of the top layer is removed;  
during the plasma etch process, means for detecting for a presence of  
the chemical-containing contaminant using one of an Auger Electron Spectroscopy  
system or Energy Dispersive X-ray Analysis system; and  
10 if present, means for determining whether the presence of the  
chemical-containing contaminant exceeds a threshold limit.

18. A method for monitoring in-situ a chemical composition  
at or near a top surface of a wafer during plasma etch to detect defects comprising:  
providing a semiconductor substrate comprising at least one top layer,  
15 wherein the semiconductor substrate comprises at least one chemical-containing  
contaminant;  
subjecting the semiconductor substrate to a plasma etch process,  
whereby at least a portion of the top layer is removed;  
during the plasma etch process, detecting for a presence of the  
20 chemical-containing contaminant using one of an Auger Electron Spectroscopy  
system or Energy Dispersive X-ray Analysis system; and  
if present, suspending the semiconductor fabrication process when the  
at least one chemical-containing contaminant exceeds a threshold limit.

19. The method of claim 18, wherein the at least one chemical-containing  
25 contaminant includes any one of carbon, calcium, sulfur, aluminum, tungsten and  
nickel.

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20. The system of claim 18, wherein the Auger Electron Spectroscopy system indicates the presence of the one or more chemical contaminants at the surface of the top layer or at about a 1-5 nm depth from the top layer surface.

21. The system of claim 18, wherein the Energy Dispersive X-ray Analysis system indicates the presence of the one or more chemical contaminants at about a 1-2  
5  $\mu\text{m}$  depth from the top layer surface.